CLAIMS

What is claimed is:

1. A method of increasing the gas transmission rate of a packaging film comprising the steps of:

providing a packaging film comprising at least about 0.001 weight % of single-walled carbon nanotube material based on the weight of the film; and

exposing the packaging film to an amount of radiation energy effective to increase the oxygen transmission rate of the packaging film by at least about 100 cubic centimeters (at standard temperature and pressure) per square meter per day per 1 atmosphere of oxygen pressure differential measured at 0% relative humidity and 23°C.

2. The method of claim 1 wherein the radiation energy amount comprises a surface dose of non-ionizing radiation of at least about 0.01 mJ/cm2 that is delivered within a duration of at most about 30 seconds.

3. The method of claim 1 wherein the radiation energy amount comprises a surface dose of non-ionizing radiation of at least about 1 mJ/cm2 that is delivered within a duration of at most about 10 seconds.

4. The method of claim 1 wherein the radiation exposure step comprises a radiation intensity of non-ionizing radiation at the surface of the packaging film of at least about 10 mW/cm2.

5. The method of claim 1 wherein the radiation exposure step comprises a radiation intensity of non-ionizing radiation at the surface of the packaging film of at least about 50 mW/cm2.

6. The method of claim 1 wherein the radiation exposure step comprises a radiation intensity of non-ionizing radiation at the surface of the packaging film of at least about 100 mW/cm2.

7. The method of claim 1 wherein the radiation exposure step comprises a radiation intensity of non-ionizing radiation at the surface of the packaging film of at least about 500 mW/cm2.

8. The method of claim 1 wherein the radiation energy amount comprises an absorbed dose of ionizing radiation absorbed by the packaging film of at least about 0.1 kGy that is delivered within a duration of at most about 30 seconds.

9. The method of claim 1 wherein the radiation energy amount comprises an absorbed dose of ionizing radiation absorbed by the packaging film of at least about 10 kGy that is delivered within a duration of at most about 5 seconds.

10. The method of claim 1 wherein:

the packaging film of the providing step comprises at least one layer comprising at least about 50 % of the single-walled carbon nanotube material by weight of the total amount of single-walled carbon nanotube material in the packaging film; and

the radiation energy amount comprises an absorbed dose of ionizing radiation absorbed by the at least one layer of at least about 0.1 kGy that is delivered within a duration of at most about 30 seconds.

11. The method of claim 1 wherein:

the packaging film of the providing step comprises at least one layer comprising at least about 50 % of the single-walled carbon nanotube material by weight of the total amount of single-walled carbon nanotube material in the packaging film; and

the radiation energy amount comprises an absorbed dose of ionizing radiation absorbed by the at least one layer of at least about 10 kGy that is delivered within a duration of at most about 5 seconds.

12. The method of claim 1 wherein the packaging film of the providing step has an oxygen transmission rate of at most about 100 cubic centimeters (at standard temperature and pressure) per square meter per day per 1 atmosphere of oxygen pressure differential measured at 0% relative humidity and 23°C.

13. The method of claim 1 wherein the packaging film of the providing step has an oxygen transmission rate of at most about 50 cubic centimeters (at standard temperature and pressure) per square meter per day per 1 atmosphere of oxygen pressure differential measured at 0% relative humidity and 23°C.

14. The method of claim 1 wherein the packaging film of the providing step has an oxygen transmission rate of at most about 10 cubic centimeters (at standard temperature and pressure) per square meter per day per 1 atmosphere of oxygen pressure differential measured at 0% relative humidity and 23°C.

15. The method of claim 1 wherein the exposing step increases the oxygen transmission rate of the packaging film by at least about 1,000 cubic centimeters (at standard temperature and pressure) per square meter per day per 1 atmosphere of oxygen pressure differential measured at 0% relative humidity and 23°C.

16. The method of claim 1 wherein the exposing step increases the oxygen transmission rate of the packaging film by at least about 10,000 cubic centimeters (at standard temperature and pressure) per square meter per day per 1 atmosphere of oxygen pressure differential measured at 0% relative humidity and 23°C.

17. The method of claim 1 wherein:

the packaging film of the providing step has an oxygen transmission rate of at most about 100 cubic centimeters (at standard temperature and pressure) per square meter per day per 1 atmosphere of oxygen pressure differential measured at 0% relative humidity and 23°C; and

the packaging film after the exposing step has an oxygen transmission rate of at least about 1,000 cubic centimeters (at standard temperature and pressure) per square meter per day per 1 atmosphere of oxygen pressure differential measured at 0% relative humidity and 23°C.

18. The method of claim 1 wherein the packaging film of the providing step comprises:

100 weight parts oxygen barrier polymer selected from one or more of ethylene/vinyl alcohol copolymer, polyvinyl alcohol, vinylidene chloride polymer, polyalkylene carbonate, polyester, polyacrylonitrile, and polyamide; and

at least about 0.001 weight parts of the single-walled carbon nanotube material per 100 weight parts oxygen barrier polymer.

19. The method of claim 18 wherein the packaging film of the providing step comprises at least one layer comprising at least a portion of the oxygen barrier polymer and at least a portion of the single-walled carbon nanotube material.

20. The method of claim 18 wherein the packaging film of the providing step comprises at least one layer comprising at least about 50 % of the oxygen barrier polymer by weight of the total amount of oxygen barrier polymer in the packaging film and at least about 50 % of the single-walled carbon nanotube material by weight of the total amount of single-walled carbon nanotube material in the packaging film.

21. The method of claim 18 wherein the packaging film of the providing step comprises at least one layer comprising at least about 90 % of the oxygen barrier polymer by weight of the total amount of oxygen barrier polymer in the packaging film and at least about 90

% of the single-walled carbon nanotube material by weight of the total amount of single-walled carbon nanotube material in the packaging film.

22. The method of claim 18 wherein:

the oxygen barrier polymer comprises ethylene/vinyl alcohol copolymer; and

the packaging film of the providing step comprises at least about 0.1 weight parts of the single-walled carbon nanotube material per 100 weight parts oxygen barrier polymer.

23. The method of claim 18 wherein:

the oxygen barrier polymer comprises vinylidene chloride polymer; and

the packaging film of the providing step comprises at least about 0.1 weight parts of the single-walled carbon nanotube material per 100 weight parts oxygen barrier polymer.

24. The method of claim 18 wherein:

the oxygen barrier polymer comprises polyamide; and

the packaging film of the providing step comprises at least about 0.1 weight parts of the single-walled carbon nanotube material per 100 weight parts oxygen barrier polymer.

25. The method of claim 18 wherein the packaging film of the providing step comprises:

100 weight parts oxygen barrier polymer selected from one or more of polyvinyl alcohol, polyalkylene carbonate, polyester, and polyacrylonitrile; and

at least about 0.1 weight parts of the single-walled carbon nanotube material per 100 weight parts oxygen barrier polymer.

26. The method of claim 1 wherein the step of exposing to the effective amount of radiation energy occurs within at most about 30 seconds.

27. The method of claim 1 wherein the step of exposing to the effective amount of radiation energy occurs within at most about 10 seconds.

28. The method of claim 1 wherein the step of exposing to the effective amount of radiation energy occurs within at most about 1 second.

29. The method of claim 1 wherein the step of exposing to the effective amount of radiation energy occurs within at most about 0.01 seconds.

30. The method of claim 1 wherein the radiation exposure step comprises exposing to an effective amount of non-ionizing radiation comprising at least about 50% visible light energy.

31. The method of claim 1 wherein the radiation exposure step comprises exposing to an effective amount of non-ionizing radiation comprising at least about 50% infrared light energy.

32. The method of claim 1 wherein the radiation exposure step comprises exposing to an effective amount of non-ionizing radiation comprising at least about 50% ultraviolet light energy.

33. The method of claim 1 wherein the radiation exposure step comprises exposing to an effective amount of ionizing radiation comprising at least about 50% electron beam energy.

34. The method of claim 1 wherein the radiation exposure step comprises exposing to an effective amount of ionizing radiation comprising at least about 50% x-ray energy.

35. The method of claim 1 wherein the effective amount of radiation energy of the exposing step is delivered discontinuously by at least two pulses.

36. The method of claim 1 wherein the packaging film of the providing step comprises at least one layer comprising at least about 0.5 weight % single-walled carbon nanotube material by weight of the layer.

37. The method of claim 1 wherein the packaging film of the providing step comprises at least one layer comprising at least about 1 weight % single-walled carbon nanotube material by weight of the layer.

38. The method of claim 1 wherein the packaging film of the providing step comprises at least one layer comprising at least about 5 weight % of single-walled carbon nanotube material by weight of the layer.

39. The method of claim 1 wherein the exposing step structurally disrupts at least a portion of the single-walled carbon nanotube material present in the packaging film of the providing step.

40. The method of claim 1 wherein the exposing step structurally disrupts at least about 50 weight % of the single-walled carbon nanotube material present in the packaging film of the providing step.

41. The method of claim 1 wherein:

the packaging film of the providing step is unperforated; and

the exposing of the packaging film to the effective amount of radiation energy causes the packaging film to be perforated with a plurality of apertures.

42. The method of claim 1 wherein:

the packaging film of the providing step comprises a first layer comprising:

at least about 50 % of the single-walled carbon nanotube material by weight of the total amount of single-walled carbon nanotube material in the packaging film; and

a thickness of at most about 50 % of the total thickness of the packaging film;

the packaging film of the providing step is unperforated; and

the exposing of the packaging film to the effective amount of radiation energy causes the packaging film to be perforated with a plurality of apertures.

43. The method of claim 1 wherein the packaging film comprises:

an outer layer of the film; and

one or more discontinuous regions supported by the outer layer of the film, wherein the one or more discontinuous regions comprise at least a portion of the single-walled carbon nanotube material.

44. The method of claim 1 wherein the packaging film comprises:

an outer layer of the film; and

one or more discontinuous regions supported by the outer layer of the film, wherein the one or more discontinuous regions comprise thermoplastic polymer and at least a portion of the single-walled carbon nanotube material.

45. A packaging film comprising at least one layer comprising:

100 weight parts of oxygen barrier polymer selected from one or more of ethylene/vinyl alcohol copolymer, polyvinyl alcohol, vinylidene chloride polymer, polyalkylene carbonate, polyester, polyacrylonitrile, and polyamide; and

at least about 0.001 weight parts of single-walled carbon nanotube material per 100 weight parts oxygen barrier polymer.

46. The film of claim 45 wherein the at least one layer comprises at least about 50% oxygen barrier polymer and at least about 0.001% single-walled nanotube material based on the weight of the at least one layer.

47. The film of claim 45 wherein the at least one layer comprises at least about 80% oxygen barrier polymer and at least about 0.1% single-walled nanotube material based on the weight of the at least one layer.

48. The film of claim 45 wherein the oxygen barrier polymer comprises ethylene/vinyl alcohol copolymer.

49. The film of claim 45 wherein the oxygen barrier polymer comprises vinylidene chloride polymer.

50. The film of claim 45 wherein the oxygen barrier polymer is selected from one or more of polyvinyl alcohol, polyalkylene carbonate, polyester, polyacrylonitrile, and polyamide.

51. The film of claim 45 wherein the packaging film of the providing step has an average transparency of at least about 85%.

52. A packaged food product comprising:

a package comprising the packaging film of claim 45 and defining an interior space;

a food product enclosed in the interior space of the package; and

a modified atmosphere enclosed in the interior space of the package.

53. A method of supplying a packaged food product comprising the following steps:

providing the packaged food product of claim 52; and

exposing the packaging film of the packaged food product to an amount of radiation energy effective to increase the oxygen transmission rate of the packaging film by at least about 100 cubic centimeters (at standard temperature and pressure) per square meter per day per 1 atmosphere of oxygen pressure differential measured at 0% relative humidity and 23°C.

54. A packaging film comprising:

at least one layer; and

one or more discontinuous regions supported by the at least one layer, wherein the one or more discontinuous regions comprise at least about 0.001 weight % of single-walled carbon nanotube material based on the weight of the film.

55. The film of claim 54 wherein the at least one layer is an outer layer of the film.

56. The film of claim 54 wherein the at least one layer is an internal layer of the film, whereby the one or more discontinuous regions are between at least two layers of the film.

57. The film of claim 54 wherein the one or more discontinuous regions comprise one or more thermoplastic polymers.

58. The film of claim 57 wherein the film comprises:

100 weight parts of oxygen barrier polymer selected from one or more of ethylene/vinyl alcohol copolymer, polyvinyl alcohol, vinylidene chloride polymer, polyalkylene carbonate, polyester, polyacrylonitrile, and polyamide; and

at least about 0.001 weight parts of single-walled carbon nanotube material per 100 weight parts oxygen barrier polymer.

59. The film of claim 58 wherein the one or more discontinuous regions comprise one or more printing inks.

60. A method of increasing the gas transmission rate of a packaging film comprising the steps of:

providing a packaging film comprising at least about 0.001 weight % of single-walled carbon nanotube material based on the weight of the film; and

exposing the packaging film to an amount of radiation energy effective to increase the water vapor transmission rate of the packaging film by at least about 5 grams/100 in^2.24hours (100% humidity, 23°C).